Observations made in order to determine whether the light of this Nova exhibited the change of focus observed in the light of Nova Persei gave at first, negative results, but careful observations made on April 27 indicated that the light of the Nova, when compared with that of an ordinary star, showed a difference of +0·08 inch (2·00mm.) in focus.

The crimson image observed on March 30 had disappeared on April 27, the out-of-focus image of the Nova then resembling that of an ordinary star. Cloudy weather at Yerkes from April 7–27 prevented Prof. Barnard from determining the exact date at which this change took place. The magnitude of the Nova is exhibiting the same periodical fluctuations as were observed in the case of Nova Persei.

THE RED SPOT ON JUPITER.—In No. 3875 of the *Astronomische Nachrichten*, Mr. Stanley J. Williams describes, and gives the detailed results of, his observations of the "great red spot" during the opposition of 1902.

Transit observations of the middle of the spot gave a rotational period of 9h. 55m. 39·55s., and of the "following" end of the spot 9h. 55m. 39·88s.; taking the weighted mean of these observations, Mr. Williams obtains, from 275 rotations, 9h. 55m. 39·66s. as the result. This shows a further considerable acceleration of the rotational period of the red spot, amounting to 1·26s., as compared with the result obtained during the opposition of 1901.

THE STUDY OF VERY FAINT SPECTRA.—In a dissertation published in No. 35 of the Lick Observatory *Bulletins*, Mr. Harold K. Palmer describes an arrangement whereby the Crossley reflector has been adapted to the study of very faint stellar and nebular spectra.

The work was first suggested, but not completed, by the late Prof. Keeler for the purpose of obtaining, amongst other spectra, the spectrum of the faint central star of the ring nebula in Lyra.

A modified form of Prof. Keeler's proposed spectroscope has now been adopted, and the results obtained with it are very satisfactory; its essential features are as follows:—A concave quartz lens intercepts the converging beam of light from the large mirror, and renders the rays parallel; these parallel rays are then refracted by a 50° quartz prism and are focused on to the photographic plate by a convex quartz lens placed between the prism and the plate. The two lenses and the prism each have an aperture of 25 mm. An arrangement attached to the prism cell allows the prism to be moved to one side, so that the spectroscope may be focused for the incident light by means of an eye-piece which carries a finely divided scale, and another eye-piece, placed at the side of the movable slipping plate, allows the "following" during exposure to be performed in the usual manner.

Spectrograms of such faint objects as the stellar nebula NGC 6807 (magnitude 13), the Novæ in Perseus (1901), Auriga and Cygnus (1876), and the Wolf-Rayet star No. 43 have been obtained with exposures varying from one to four hours, and show a fair amount of detail.

Three spectrograms of the ring nebula were obtained, two with thirty minutes' and one with two hours' exposure, but the only trace of the central star is a faint line which appears on all three plates, and, in the longer exposure, shows a faint dot in a position a little to the more refrangible side of the condensation λ 373 in the nebula ring. A detailed description of each of the spectra obtained is given in Mr. Palmer's paper.

INSTITUTION OF NAVAL ARCHITECTS.

THE Institution of Naval Architects held its summer meeting this year in Ireland, commencing Tuesday, June 23, when the opening meeting was held in Queen's College, Glasgow, the president of the Institution occupying the chair.

After the usual formal proceedings, in which the members were welcomed to the city by Sir Daniel Dixon, the Lord Mayor of Belfast, and the Rev. Dr. Hamilton, president of Queen's College, three papers were read. The first was by Mr. C. F. L. Giles, the engineer to the Belfast Harbour Commissioners, and gave a brief description of the harbour and its development. Mr. E. H. Tennyson D'Eyncourt followed with a paper "On Fast Coaling Ships for our Navy." The author proposed that certain vessels should be built specially to wait on the fleet and supply it with coal in time of war, and they should be fitted with appliances for transferring the fuel to the warships at sea. These vessels should be able to steam 17 knots easily and continuously, and 18 knots in case of emergency. They would have to be of considerable size, therefore, and would be loaded with 10,000 tons of coal, besides that needed for their own use. The author estimated that the requirements could be met on a length of 550 feet, a beam of 66 feet, and a draught of 27 feet with 10,000 tons of coal on board; that would enable the vessels to get through the Suez Canal. The horse-power necessary for 17 knots would be about 12,000. With quadruple engines the consumption of coal would be 1½lb. per I.H.P. per hour, so that at full speed the collier could go 1000 miles from the coaling station and back on 800 tons of coal, carrying 10,000 tons of coal for the use of the fleet. That would be sufficient to coal completely five of our largest battleships or cruisers, or, if needed, ten such battleships could have their bunkers half full.

Comparing this with the present conditions, it would take one of our large cruisers or ironclads four or five days to make the 2000 miles, and she would lose at least 1000 tons of coal, and have to be steaming hard all the time. The vessel would arrive with dirty boilers, a tired complement of stokers, and the greater part of her coal already burnt. In ordinary peace time the colliers could be used for taking coal to the coaling stations. The cost of these vessels, fully equipped, with Temperley transporters and all the necessaries for quick coaling, would be about 270,000*l*. each, so that four or five could be built for the cost of one first-class armour-clad or cruiser, whilst four could be kept in commission for about the cost of keeping up an armour-clad. In time of war, the author claimed, each collier would be equal to several additional warships, as it would enable so many of the latter to remain at sea, saving them the time of going to and fro for coal, and giving them an opportunity to clean their boilers and do minor repairs to the engines, besides resting the whole crew, officers and men. In the discussion which followed the reading of this paper, it was pointed out that it was more reasonable to transform a mercantile vessel into a collier in time of war than to build such vessels purposely for an occasion that might never arise.

Mr. James Hamilton, of Glasgow, next read a paper in which he described an ingenious means which he had devised for converting a moderate speed steamer into one of very high speed for war-like purposes. He pointed out that the extreme speed now demanded by the Admiralty for the new mercantile cruisers to which it was proposed to give subsidies was higher than could be used, with profit to the owners, during peace time for ordinary Transatlantic service. The Admiralty asked 25 knots; Mr. Hamilton put the limit for mercantile use at 22 knots. If engines are not worked up to the power for which they are designed, they are uneconomical in themselves, whilst for excessive speeds very great engine power is needed. In order to solve this difficulty, Mr. Hamilton proposes triple-screw steamers, with one central screw and two wing screws. For the 25-knot speed all three screws would be used, and their respective engines would therefore be at work at their full power, and so be operating economically; for the 22-knot speed the two wing screws only would be used, and in order to prevent the drag of the central, idle propeller, the latter is drawn forward, with its shaft, until the blades of the screw touch the stern-post of the ship. This stern-post is so formed that the blades lie snugly against it, and in this way the resistance of the water flowing past the idle propeller is got rid of. For a four-bladed screw the stern-post is made of cruciform shape by the addition of two horizontal wings. In the discussion on the paper, it was pointed out that the shape of the stern-post was not favourable to speed on account of the eddy-making resistance. Mr. Hamilton, in reply to the discussion, said, however, that the objection was not of so serious a nature as was supposed, supporting his contention by diagrams illustrating the stream-line theory.

On the second day of the meeting, Wednesday, June 24, Prof. J. H. Biles read a paper "On Cross-Channel Steamers," in the course of which he gave particulars of certain vessels, and discussed the different qualities needed

for success in this particular kind of craft. The paper was illustrated by a large number of drawings of various vessels.

A paper "On Registered Tonnages, and their Relation to Fiscal Charges and Design" was read by Mr. James Maxton. In this the author pointed out some of the absurdities and anomalies incidental to the present stage of the law in regard to the tonnage of ships. A long discussion followed, in the course of which many speakers gave expression to the opinion that a change in the law was absolutely necessary in the interests of shipowners, harbour authorities, and, also, passengers. Several shipowners who spoke laid it down as a principle that in cross-channel steamers every passenger should have a separate berth, and it was only the way in which tonnage was measured that prevented such a desirable feature being introduced.

Prof. W. H. Watkinson read a paper in which he described some new features of superheaters. He pointed out that, even with a separate condenser, and all the other improvements that have been made since the time of Watt, from 12 per cent. to 30 per cent. of the steam supplied to an engine is condensed during its admission to the cylinder. The steam turbine is the only engine in which this condensation of the steam by previously cooled surfaces does not take place, but the steam in turbines is wet from expansion while doing work. Liquefaction of steam may be reduced by steam jacketing; by compounding the cylinders; by steam separators; by a special arrangement for sweeping the condensed steam out of the cylinder at each stroke; by reduction of clearance surface; and by superheating. The last, the author said, was by far the most effective. During superheating, although the pressure of the steam remains constant, its volume is greatly increased. The amount of heat required to superheat 1lb. of steam by 150° F. is 72 British heat units; this is only about 6 per cent. of the heat required to generate 1lb. of dry saturated steam. The increase in volume due to this additional 6 per cent. of heat averages about 30 per cent. In some cases where superheated steam is used, the superheating is only carried so far as to reduce, or at most to annihilate, initial condensation. In these cases the steam, after it has been admitted to the cylinder of an engine, becomes ordinary saturated steam before or at cut-off, so that during expansion some condensation of steam takes place, due to work being done at the expense of the internal heat of the steam. There is, then, no advantage due to the increase of volume of the steam during superheating, but there is great saving in steam and in coal, due to the reduction of initial condensation and leakage of steam past the valves and pistons. In the case of large engines of the usual type, it is not possible to superheat the steam by more than 200° F., and in some cases there is trouble with the valves if the degree of superheat exceeds 150° F. With piston valves the limit can be considerably exceeded. The author next discussed the question of independently-fired superheaters, and those in which the apparatus is placed in the uptake of the boiler or is heated by gases from the furnace. A superheater to which a gas-producer was attached was also illustrated and described by the author.

In the discussion on this paper, Mr. A. F. Yarrow said that superheating was the direction in which engineers must look for improvement in the economy of the steam engine. The difficulty in lubricating the cylinders of steam engines had been spoken of, but it was well known amongst engineers that for years the torpedo boat builders had never used internal lubrication for the engines of the craft they built. It was interesting to note that water would ooze through places where steam would not pass, and for this reason piston valves might be worked with superheated steam without metal being in rubbing contact with metal. Mr. A. Morcom gave some particulars of a vertical engine in which superheated steam had been used. It was a 500kw. engine, and the steam was at 600° F. With saturated steam the consumption of water per kilowatt-hour was 21lb.; with superheated steam it was 16lb.

During the stay in Belfast, the shipyard and engine works of Messrs. Harland and Wolff, and those of Messrs. Workman and Clark, were visited. There was a steamer trip down Belfast Lough, a reception at the harbour offices, and a dinner given by the Right Hon. W. J. Pirrie at his residence at Ormiston.

On Thursday, June 25, members proceeded to Dublin, where they attended a garden party given by the Lord Lieutenant at the Vice-regal Lodge; rain entirely spoilt the pleasure of the reception. In the evening there was a ball at the Mansion House.

On the following day the members met in the lecture theatre of the Royal Dublin Society, when Mr. A. F. Yarrow, vice-president of the Institution, occupied the chair. A paper by the Hon. C. A. Parsons was first taken, the subject being "Modern Steam Turbines, and their Application to the Propulsion of Vessels." The paper was largely of an historical nature, and gave particulars of the various vessels in which the steam turbine had been fitted, such as the two unfortunate torpedo-boat destroyers, *Viper* and *Cobra*, which were both lost at sea. The *King Edward* and *Queen Alexandra* were two passenger steamers that had been running successfully on the Clyde. The *Queen* is a cross-channel steamer, built for the Dover-Calais route, and has been put on her station since the paper was read. She has machinery of 8000 I.H.P. On her trial on the Skelmorlie mile she made a mean speed of 21·73 knots. Another boat of the same type, to be fitted with turbine engines, has been built for the L.B. and S.C.R., and will be put on the Newhaven-Dieppe route. She is 280 feet long and of 34 feet beam, and will shortly be launched. Three large yachts have lately been fitted with steam turbines, the largest being the *Lorena*, built by Messrs. Ramage and Fergusson, of Leith. She is 253 feet in length and of 33 feet 3 inches beam. The steam turbines in this vessel are similar to those of the *King Edward* and *Queen Alexandra*, but somewhat larger. The trial of the *Lorena* took place in the Firth of Forth in May, the speed attained being 18 knots. The turbine yacht, the *Tarantula*, built for the late Colonel McCalmont by Messrs. Yarrow and Co., was of the torpedo-boat type, but with somewhat heavier scantlings. She made 25·36 knots on her trial trip, her displacement being 150 tons. The *Velox* is a torpedo-boat destroyer recently purchased by the British Admiralty. She has machinery similar to that which was in the *Viper*, and will be capable of developing upwards of 10,000 H.P. Two small triple-expansion reciprocating engines, each of 150 H.P., are fitted for cruising speeds up to 13 knots. The steam from these exhausts into the turbines, where its expansion is completed before it passes to the condensers. Another torpedo-boat destroyer, the *Eden*, will have machinery of 7000 H.P., and her speed will be $25\frac{1}{2}$ knots; whilst a third-class cruiser, *Amethyst*, built for the British Government, will have turbines of 9800 I.H.P., her speed being $21\frac{3}{4}$ knots. The author looked forward to the time when steam turbines would be fitted to vessels of the largest size, such as Atlantic liners. The experience with the marine turbine up to 10,000 H.P. in ships of fast as well as of moderate speed had tended, he claimed, to justify the anticipation—guided by theory—that the larger the engines the more favourable would be the results as compared with the reciprocating engines. The saving in weight, space, attendance and power would be still more marked with turbine engines of above 10,000 H.P., and up to 60,000 H.P., for which designs had been prepared.

The remaining paper read at the meeting was on the Dublin Harbour works, the author being Mr. J. P. Griffith. During their stay in Dublin the visitors took a steamer trip down the Dublin Bay, and on the evening of Friday the Institution dinner brought the meeting to a close.

THE INTERNATIONAL CONGRESS FOR APPLIED CHEMISTRY.[1]

So many papers on analytical methods were presented that it is impossible even to enumerate them. The International Commissions on Analysis and on the Analysis of Fodders and Manures had not received all the reports yet which the Paris meeting had called for; the two Commissions over which G. Lunge presided—Maercker (Halle), chairman of the second Commission, having died—held some of their meetings jointly with sections i. (analysis) and vii. (agricultural chemistry). The proposals for a uniform method of drawing up analytical reports were made by W. Fresenius (Wiesbaden); Ch. Guillaume (Sèvres) reported

[1] Continued from p. 158.